APPLICATION FOR
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FOR

IMPLOSION RESISTANT CONTAINER

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BACKGROUND OF THE INVENTION

1. Cross-Reference to Related Application:

This application is a continuation-in-part of U.S. patent application Ser. No. 10/032,654, filed on October 29, 2001, the technical disclosure of which is hereby incorporated herein by reference.

2. Technical Field:

The present invention generally relates to containers for storing fragile food products, and more particularly, to a blow molded container for storing potato chips and/or crisps, corn based chips and/or crisps, cookies and the like which is capable of adapting to changing environmental conditions while maintaining its visual aesthetic appearance.

3. Description of the Related Art:

There are presently a great number of containers known for the storage of fragile food products (*e.g.*, snack chips, crisps, cookies and the like). Inherent in every container's design is the requirement to compensate for or adapt to changing environmental conditions. Changes in environmental conditions (*i.e.*, temperature, pressure and humidity) are a natural consequence of manufacturing processes. For example, dry food products are typically manufactured at elevated temperatures and thereafter hermetically sealed to protect the product from spoiling. Once sealed, a certain amount of gas is trapped within the container. As the contents of the hermetically sealed package cool to an ambient temperature, a partial vacuum is created which may cause the container to implode, distort or destroy the seal.

Changes in atmospheric pressure also affect the volume of gas trapped within a container. This is normally not a problem for dry food products because they are typically packaged in flexible packages (*e.g.*, bags and flexible film overwraps) that can adjust their shape to changing environmental conditions. However, flexible packages

offer little, if any, protection from outside physical forces to the contained fragile food products. Thus, increasingly, a need to use more rigid containers has arisen.

While rigid containers constructed of paper and foil are well known in the art, their utilization in packaging fragile food products presents many inherent drawbacks. The manufacturing costs of such rigid containers are relatively high. Moreover, in order to provide enough strength to resist forces induced by environmental change, the weight of such containers is relatively high. Additionally, changes in humidity can adversely affect the structural integrity of such containers.

Containers constructed of thermo-plastic substances are increasingly gaining in popularity for packaging fragile food products. However, packaging fragile dry food products utilizing current thermo-plastic container technology is still problematic. While previous efforts have addressed the problems associated with utilizing thermo-plastic containers in packaging liquid products, these efforts have not addressed the inherent problems associated with packaging fragile dry food products. Fragile dry food products (*e.g.*, snack foods, baked goods and cereals) contain significantly larger amounts of entrapped gas, both within their structure as well as in their surrounding packaging, than do liquid products. The effect environmental changes impart on this larger volume of entrapped gas profoundly affects the packaging requirements of fragile dry food products. Currently, thermo-plastic technology offers two basic alternatives for manufacturing plastic containers that adapt to or compensate for changing environmental conditions.

First, by increasing the thickness of the container's sidewall, a thermo-plastic container may be fashioned which is strong enough to resist forces induced by changing environmental conditions. However, such containers are generally undesirable in that they are expensive, in terms of materials, to manufacture and their weight is relatively high. Moreover, they are less environmentally friendly in that their ability to biodegrade is generally more protracted than thinner walled containers.

Alternatively, the thickness of a container's sidewall may be reduced so as to fashion a thermo-plastic container capable of adjusting its shape to changes in

environmental conditions like a flexible package, but being sufficiently rigid to offer some protection from outside physical forces. However, such containers have significant commercial drawbacks. While it is currently possible to fashion a relatively thin walled thermo-plastic container that is capable of withstanding expansion forces resulting when the container's interior pressure is greater than the ambient pressure; such thin walled thermo-plastic containers tend to buckle, deform, or implode in a generally unpredictable manner when the interior pressure is less than the ambient pressure (*e.g.*, the vacuum inducing manufacturing process discussed previously). Such deformation or implosion tends to detract from the commercial presentation of the container and often is interpreted as a damaged or defective product by purchasing consumers.

A variety of proposals have previously been made to circumvent the problems inherent in designing thermo-plastic containers capable of adapting to environmental changes. For Example, U.S. Patent No. 6,074,677 to Croft discloses a composite food container comprised of a vacuum packed inner flexible bag 60 and a rigid plastic tubular outer container 20. While the rigid plastic outer container 20 protects the container's contents, the differential between the vacuum in the inner flexible bag 60 and the vacuum in the region R between the inner bag and the outer container is sufficiently maintained so as to prevent the spoilage of the food product within the inner bag 60. However, such a container is both complicated and relatively expensive to manufacture.

Another prior proposal is U.S. Patent No. 5,921,429 to Gruenbacher *et al.* which discloses a substantially rectangular plastic container for multiple, side-by-side stacks of fragile food articles comprised of a single blow molded body. Key to the Gruenbacher *et al.* '429's design is the inclusion of an internal partition 16 having two spaced apart walls 26 and 28 which are adapted to deform in the presence of vacuum and pressure in the compartments such that the outer perimeter dimension of the container remains substantially the same and the wrap around labeling retains its fit. In addition to requiring a relatively complicated manufacturing process, the Gruenbacher *et al.* '429 design is not suited to packaging a single stack of fragile food articles.

A need, therefore, exists for an improved blow molded thermo-plastic container which is relatively simple to manufacture and strong enough to resist external compressive force, yet capable of adapting to changes in environmental conditions without adversely impacting the commercial presentation of the container.

SUMMARY OF THE INVENTION

The present invention overcomes many of the shortcomings inherent in previous containers for packaging potato chips and/or crisps, corn based chips and/or crisps, cookies and the like. The improved container of the present invention generally comprises a tubular body having a sidewall, a permanently closed end and an opposing hermetically sealable open end. The improved implosion-resistant container of the present invention utilizes a collection of stress dissipating mechanisms that counteract the forces causing deformation, implosion and loss of seal integrity in hermetically sealable thermo-plastic containers. This collection of stress dissipating mechanisms, employed collectively or separately, allows a hermetically sealable container for storing fragile food products to be fashioned as a relatively lightweight, thin-walled blow molded thermo-plastic container that is capable of adapting to changing environmental conditions while maintaining its visual aesthetic appearance.

The improved container of the present invention may include structural rigidity mechanisms that strengthen the structural integrity of hermetically sealed containers so as to withstand forces induced by changes in environmental conditions. In one embodiment, the structural rigidity mechanism may comprise molded ribs and "C" beams in a corrugated pattern traversing the longitudinal axis of the container. Alternatively, randomly spaced three-dimensional figures formed into the sidewall of the thermo-plastic container may also be employed as structural rigidity mechanisms.

The improved container of the present invention may also include a floating panel mechanism that allows a hermetically sealed container to adjust its internal volume in response to changes in environmental conditions without detracting from the commercial presentation of the container. The floating panel mechanism comprises a stable panel area defined by a flexible corrugated suspension ring formed within the confines of a planar surface fashioned in the curved sidewall of the container. The flexible corrugated suspension ring surrounding the stable panel area allows the entire stable panel area to move uniformly without randomly distorting or buckling the container.

The improved container of the present invention may also include a morphing geometries mechanism comprising an annular bellows means which is formed in the tubular body of a container and allows a hermetically sealed container to repeatedly increase or decrease its internal volume to counteract changing environmental conditions.

The improved container of the present invention may also include a flowing geometries mechanism that allows a hermetically sealed container to smoothly change its geometry to counteract changes in environmental conditions thereby avoiding the random buckling and deformation inherent in current packaging techniques which detracts from the commercial presentation of the container. Flowing geometries mechanisms typically comprise one or more weakened panel area formed in the sidewall of the container between tubular support structures comprising the container's base and top sections. Flexible hinge areas situated between the weakened panel area and the tubular support structures allow the container to change its internal volume in response to changes in environmental conditions without detracting from the visual aesthetics of the container. The forces generated by changes in environmental conditions are focused on the panel area, which contracts and expands uniformly in response (*i.e.*, the entire panel area flexes in and out in relation to the container sidewall). The panel areas may further comprise a series of parallel V-grooves formed therein, which serve to stiffen the panel area by distributing forces more evenly. The panel area thereby flexes as a unitary panel in a more evenly balanced manner. The panel areas may have either planar or curved cross sections, thereby allowing a wide variety of container designs and shapes.

Thus, the improved container of the present invention may comprise one or more of the aforementioned stress dissipating mechanisms, acting separately or collectively, to counteract the forces induced by changing environmental conditions. Consequently, while the container of the present invention generally comprises at least one stress dissipating mechanisms formed in a generally tubular body, in accordance with the teachings of the present invention, numerous embodiments of hermetically sealable thermo-plastic, blow-molded containers are possible.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

FIGS. 1*a*, 1*b*, 2*a*, and **2*b*** are perspective views of alternative embodiments of container of the present invention illustrating the employment of corrugated sides to induce structural rigidity;

FIG. 3 is a perspective view of the container of the present invention illustrating the employment of three-dimensional shape molding to induce structural rigidity;

FIG. 4*a* is a perspective view of the container of the present invention illustrating the employment of a floating panel mechanism;

FIG. 4*b* is a cross-sectional view of the container of the present invention illustrating the employment of a floating panel mechanism;

FIGS. 5*a* and **5*b*** are perspective views of the container of the present invention illustrating the employment of a morphing geometries mechanism;

FIG. 6*a* is a perspective view of the container of the present invention illustrating the employment of a flowing geometries mechanism;

FIG. 6*b* is a cut-away perspective view of the container of the present invention illustrating the employment of a flowing geometries mechanism;

FIGS. 6*c* and **6*d*** are cross-sectional views of the container of the present invention illustrating the employment of a flowing geometries mechanism.

FIG. 7*a* is a perspective view of a preferred embodiment of the container of the present invention illustrating the employment of a flowing geometries mechanism which includes a curved weakened panel area having parallel V-grooves formed therein;

FIGS. 7*b* and ***7c*** are side views of the preferred embodiment of the container of the present invention shown in FIG. 7a;

FIGS. 8*a*, 8*b* and ***8c*** are cross-sectional views of the preferred embodiment of the container of the present invention shown in FIG. 7a along line 8-8, illustrating the employment of a flowing geometries mechanism which includes a curved weakened panel area having parallel V-grooves formed therein;

FIG. 9*a* is a perspective view of another preferred embodiment of the container of the present invention illustrating the employment of a flowing geometries mechanism which includes a planar weakened panel area formed therein;

FIGS. 9*b* and ***9c*** are side views of the preferred embodiment of the container of the present invention shown in FIG. 9*a*, illustrating the employment of a flowing geometries mechanism which includes a planar weakened panel area;.

FIGS. 10 is a cross-sectional view of the preferred embodiment of the container of the present invention shown in FIG. 9*a* along line 10-10;

FIG. 11*a* is a perspective view of yet another preferred embodiment of the container of the present invention illustrating the employment of a flowing geometries mechanism having a planar weakened panel area and further comprising a floating panel mechanism formed therein; and

FIG. 11*b* is a perspective view of still yet another preferred embodiment of the container of the present invention illustrating the employment of a

morphing geometries mechanism and three-dimensional structural rigidity mechanisms in combination with the container shown in FIG. 11*a*.

Where used in the various figures of the drawing, the same numerals designate the same or similar parts. Furthermore, when the terms "top," "bottom," "first," "second," "upper," "lower," "height," "width," "length," "end," "side," "horizontal," "vertical," and similar terms are used herein, it should be understood that these terms have reference only to the structure shown in the drawing and are utilized only to facilitate describing the invention.

DETAILED DESCRIPTION OF THE DRAWINGS

The container of the present invention utilizes a collection of stress dissipating mechanisms that counteract the forces induced by changes in environmental conditions which cause deformation, implosion and loss of seal integrity in hermetically sealed containers. This collection of stress dissipating mechanisms allows a hermetically sealable container for storing fragile food products to be fashioned as a relatively lightweight, thin-walled blow molded thermo-plastic container that is capable of adapting to changing environmental conditions while maintaining its visual aesthetic appearance. The stress dissipating mechanisms employed are adaptable to container designs generally well known in the art. Thus, the various embodiments of the container of the present invention all have a generally tubular body comprising a sidewall permanently closed at one end comprising the container's base and having a hermetically sealable cap or lid. While employed collectively and/or separately, depending upon the circumstances of a specific product and its packaging requirements, the collection of stress dissipating mechanisms utilized in containers of the present invention may best be understood by examining each stress dissipating mechanism in isolation.

Structural Rigidity Mechanisms

Referring to **FIGS. 1*a***, **1*b***, **2*a***, **2*b*** and **4*a***, the use of molded ribs and "C" beams in a corrugated pattern traversing the longitudinal axis of the container may be employed to provide added strength throughout the container. Compressive and expansive forces are distributed over a larger area thereby resulting in a more structurally rigid container. The molded ribs and corrugated "C" beams may be either annular or non-annular. Thus, , as illustrated in **FIGS. 1*a*** and **1*b***, the corrugated "C" beams **10** are generally annular and perpendicular to the longitudinal axis of the container. As illustrated in **FIGS. 2*a*** and **2*b***, the corrugated "C" beams **20**, while generally annular, may also traverse about the longitudinal axis of the container in a wavy sinusoidal pattern. Alternatively, as shown in **FIG. 4*a***, non-annular ribs **40** may be formed into selected areas of a container.

Where applicable, the container may also include a smooth surface area between corrugated sections. Thus, as illustrated in **FIG. 1*b***, an upper corrugated section **12*a*** and the lower corrugated section **12*b*** may be separated by a smooth section **14** that is suitable for attaching a label **16**. Similarly, as illustrated in **FIG. 2*b***, a smooth section **24** that is suitable for attaching a label **26** may separate the upper wavy corrugated section ***22a*** and the lower wavy corrugated section **22*b***.

Referring now to **FIG. 3**, randomly spaced three-dimensional figures **30*a-j*** formed into the sidewall of a thermo-plastic container may also be employed to provide added strength throughout the container. The randomly spaced three-dimensional figures **30*a-j*** distribute compressive and expansive forces over a larger area thereby resulting in a more structurally rigid container. It is understood that the geometric three-dimensional figures **30*a-j*** illustrated in **FIG. 3** are shown to merely illustrate the concept and not to limit it. Thus, any three-dimensional figure design formed into the sidewall of a thermo-plastic container may be suitable in the appropriate circumstance. Additionally, the three-dimensional figures may also be evenly spaced for aesthetic purposes.

Floating Panel Mechanism

Referring now to **FIGS. 4*a*** and **4*b***, an embodiment of a hermetically sealable container of the present invention is shown which illustrates the utilization of a floating panel mechanism. The floating panel mechanism comprises a stable panel area **42** defined by an encompassing flexible corrugated suspension ring **44** formed within the confines of a planar surface **46** fashioned in the curved sidewall **48** of the container. The flexible corrugated suspension ring **44** surrounding the stable panel area **42** allows the entire stable panel area **42** to move uniformly (*i.e.*, spring in and out) without randomly distorting or buckling the container. Other portions of the container may be sufficiently reinforced (*e.g.*, using structural rigidity mechanisms such as corrugated ribs **40**) so that when the container is hermetically sealed, all container expansion and contraction in response to changes in environmental conditions is accomplished by the floating panel mechanism. The stable panel area **42** springs out and retracts in a direction perpendicular

to the planar surface **46**. Thus, changes in the internal gas volume induced by changes in environmental conditions may be accommodated without detracting from the commercial presentation of the container.

Morphing Geometries Mechanism

Referring now to **FIGS.** ***5a*** and ***5b***, an example of a container is shown which illustrates the utilization of a morphing geometries mechanism. The structure of a morphing geometries mechanism comprises an annular bellows means **54** formed in the tubular body **50** of the container. The annular bellows means **54** expands (shown in **FIG. 5*a***) and contracts (shown in **FIG. 5*b***) along the container's longitudinal axis allowing a hermetically sealed container to repeatedly increase or decrease its internal volume to counteract changing environmental conditions. While the example illustrated in **FIGS. 5*a*** and **5*b*** positions the annular bellows means **54** near the top of the container's tubular body, it is understood that in appropriate circumstances, the annular bellows means **54** may be positioned anywhere along the entire longitudinal length of the container's tubular body.

Flowing Geometries Mechanism

Referring now to **FIGS.** ***6a*** and ***6b***, an embodiment of a container of the present invention is shown which illustrates the utilization of a flowing geometries mechanism. Flowing geometries mechanisms are designed so as to allow a hermetically sealed container to smoothly change its geometry to counteract changes in environmental conditions thereby avoiding the random buckling and deformation inherent in current packaging techniques which detracts from the commercial presentation of the container.

For example, in the container shown in **FIGS.** ***6a*** and ***6b***, the flowing geometries mechanism comprises one or more lateral flexible hinge areas (*e.g.*, **62** and **64**) formed in the sidewall of the container **60** and defining a weakened panel area **68** situated there between. The lateral flexible hinge areas **62** and **64** effectively control the deformation of a hermetically sealed container in response to changes in environmental conditions by allowing the sealed container to flex (*i.e.*, contract and expand) the weakened panel area

68 in a smooth and uniform manner. While the container's geometry or shape is allowed to smoothly adjust to changes in environmental conditions, the deformation is controlled such that the commercial presentation of the container is not detracted from.

Referring now to **FIGS.** *6c* and *6d*, as illustrated in longitudinal cross-sectional views of the container **60** shown in **FIGS.** *6a* and *6b*, the container is **60** designed so that a small annular space (generally designated as **A**) exists between the outer periphery of the enclosed product stack **66** and the planar weakened panel area **68** of the container **60** so as to aid in the manufacturing and packaging process. The size of the container **60** may be designed such that when hermetically sealed, the inner wall of the weakened panel area **68** may contact the outer periphery of the enclosed product stack **66** when the container **60** contracts, thereby limiting the amount of controlled deformation. The enclosed product stack **66** may actually provide some measure of lateral structural support to the sidewall of the hermetically sealed container **60** when the internal pressure of the container **60** is less than the ambient atmospheric pressure.

While the lateral cross-section of the weakened panel area **68** in the embodiment of the container **60** illustrated in **FIGS.** *6a-6d*, is generally planar (*i.e.*, flat), flowing geometries mechanisms may also comprise panel areas having a curved lateral cross-section. For example, in a preferred embodiment of the container of the present invention shown in **FIGS.** *7a*, *7b* and *7c*, a flowing geometries mechanism is illustrated which comprises a panel area **84** having a curved lateral cross section. As illustrated in **Fig.** *7a*, the container **70** comprises a generally tubular body that is permanently closed at its lower end forming the container's base and having a sealable upper end. The tubular body of container **70** is comprised of a sidewall having three contiguous sections: a permanently closed lower base section **74**, a middle section **76** and a sealable upper section **72**. While the lateral cross-sections of the lower base section **74** and the upper section **72** are generally circular, the lateral cross-section of the middle section **76** is generally oval. In order to properly focus the forces induced by changes in environmental conditions on the flowing geometries mechanism, the lower base section

74 and the upper section **72** are designed to be generally more rigid in maintaining their cross-sectional shape than the middle section **76**. For example, the lower base section **74** and the upper section **72** may include structural rigidity mechanisms such as annular corrugated "C" beams **78*a***, **78*b*** which traverse about the longitudinal axis of the container in a wavy sinusoidal pattern.

The lower base section **74** and the upper section **72** also include transitional areas **74*a***, **72*a*** , respectively, wherein the generally circular lateral cross-section of the lower base section **74** and the upper section **72** transition to a generally oval cross-section of the middle section **76**. These transitional areas **74*a***, **72*a*** effectively act as flexible hinge areas to effectively control the deformation of the container in response to changes in environmental conditions.

Referring now to **Fig.** 7***b***, which depicts a side view of the container **70**, and to **Fig.** 7***c***, which depicts a side view of the container **70** shown in **Fig.** 7***b*** rotated ninety degrees about its longitudinal axis, the middle section **76** of container **70** includes a plurality of parallel grooves **80** formed in the sidewall of the middle section **76**. In one embodiment, the grooves may have a "V" shaped cross section, wherein the nadir of the "V" shape is oriented towards the interior of the container **70**. The grooves **80** are non-annular and generally evenly spaced along the longitudinal axis of the container **70**. Moreover, the grooves **80** are generally identical in dimension and vertically aligned, such that the middle section **76** of container **70** is roughly divided into longitudinal portions or sections which contain parallel grooves **80** and longitudinal portions or sections which are smooth.

For example, as shown in the side views of container **70** illustrated in **Figs.** 7***b*** and 7***c***, the middle section **76** is divided into two longitudinal sections **84*a***, **84*b*** having parallel grooves **76** formed therein and two longitudinal sections **82*a***, **82*b*** which are essentially smooth. The traverse width of the grooved longitudinal sections **84*a***, **84*b***, are typically larger than the traverse width of the smooth longitudinal sections **82*a***, **82*b***. The grooves **80** on the exterior surface of the container **70** effectively form ribs on the interior

periphery of the container **70**. Thus, as structural rigidity mechanisms, the parallel grooves **80** serve to stiffen the grooved longitudinal sections ***84a***, ***84b***, thereby distributing the compressive and expansive forces more evenly over the entire longitudinal section, enabling the container to smoothly change its geometry to counteract changes in environmental conditions and avoid the random point buckling and deformation.

As the various longitudinal sections ***82a***, ***82b***, ***84a***, ***84b*** expand and contract, the transitional areas ***74a***, ***72a*** flex to accommodate the changes in cross sectional area. However, the structural rigidity mechanisms ***78a***, ***78b*** in the upper section **72** and lower base section **74** serve to isolate the flexing from their respective distal ends. Thus, the generally circular cross-section of the bottom of the lower base section **74** remains intact. Similarly, the generally circular cross-section of the top of the upper section **72** remains essentially unchanged. Thus, any hermetic seal applied to the rim or top of the upper section **72** remains intact.

The transitional areas ***74a***, ***72a*** may comprise differing hinge profiles, which accommodate more or less flexing in accordance with the design of a container. For example, as illustrated in **FIGS.** ***7b*** and ***7c***, the container **70** includes smaller hinge profiles (*e.g.*, **HP3** and **HP1**) in sections of the transitional areas ***74a***, ***72a*** which correspond to or are aligned with the smooth longitudinal sections ***82a***, ***82b***. Correspondingly, the container **70** includes larger hinge profiles (*e.g.*, **HP4** and **HP2**) in sections of the transitional areas ***74a***, ***72a*** which correspond to or are aligned with the grooved longitudinal sections ***84a***, ***84b***. Thus, the preferred embodiment of the container **70** shown in **FIGS.** ***7a***, ***7b*** and ***7c***, is designed to accommodate more flexing in the transitional areas ***74a***, ***72a*** which correspond to or are aligned with the grooved longitudinal sections ***84a***, ***84b***.

Referring now to **FIGS.** ***8a***, ***8b*** and ***8c***, cross-sectional views of the preferred embodiment of the container **70** shown in **FIGS.** ***7a***, ***7b*** and ***7c***, are shown in a variety of environmental conditions. As noted previously, the lateral cross-sections of the lower

base section **74** and the upper section **72** are generally circular, while the lateral cross-section of the middle section **76** is generally oval. Correspondingly, the outer periphery **74'** of lower base section 74 is generally circular. The lower base section **74**, as well as the upper section **72**, is designed to be generally more rigid in maintaining its cross-sectional shape than the middle section **76**. Thus, as depicted in the three environmental conditions illustrated in **FIGS. *8a*, *8b*** and ***8c***, the outer periphery of the lower base section **74'** generally maintains its circular shape proportion regardless of the environmental condition.

The parallel grooves **80** formed in the sidewall of the middle section **76** effectively form ribs on the interior periphery surface **90** of the container **70**. The preferred embodiment of the container shown in **FIGS. *7a-c*** and ***8a-c*** also depicts the middle section **76** as being divided into two longitudinal sections ***84a***, ***84b***, which have parallel grooves **76** formed therein, and two longitudinal sections ***82a***, ***82b***, which are essentially smooth.

The lower base section **74** also includes a transitional area ***74a*** wherein the generally circular lateral cross-section of the lower base section **74** transitions to a generally oval cross-section of the middle section **76**. As noted previously, this transitional area ***74a*** effectively acts as flexible hinge area to effectively control the deformation of the container in response to changes in environmental conditions. As illustrated in **FIGS. *8a*, *8b*** and ***8c***, the transitional area ***74a*** may comprise differing hinge profiles, which accommodate more or less flexing in accordance with the design of a container. Thus, as illustrated, the container **70** includes smaller hinge profiles (*e.g.*, **HP3**) in sections of the transitional areas ***74a*** which correspond to or are aligned with the smooth longitudinal sections ***82a***, ***82b***. Correspondingly, the container **70** includes larger hinge profile (*e.g.*, **HP4**) in the sections of the transitional areas ***74a*** which correspond to or are aligned with the grooved longitudinal sections ***84a***, ***84b***. Thus, the preferred embodiment of the container **70** shown in **FIGS. *7a-c*** and ***8a-c*** is designed to

accommodate more flexing in the transitional areas **74*a*** which correspond to or are aligned with the grooved longitudinal sections **84*a***, **84*b***.

FIG. 8*a* illustrates (in somewhat exaggerated form, not necessarily to scale) a lateral cross-sectional view of the container **70** in essentially a steady state environmental condition (*i.e.*, where the internal pressure is equal to the external pressure). The lateral cross-sectional view of the outer periphery of the lower base section **74'** is generally circular while the lateral cross-sectional view of the middle section **76** comprised of the grooved longitudinal sections **84*a***, **84*b*** and the smooth longitudinal sections **82*a***, **82*b*** are generally oval.

FIG. 8*b* illustrates (in somewhat exaggerated form, not necessarily to scale) the effect of a high pressure environmental condition (*i.e.*, the external pressure is higher than the internal pressure) on the lateral cross-section of the container **70** (*e.g.*, after completion of the manufacturing process when partial vacuum is induced). Under such an environmental condition, the grooved longitudinal sections **84*a***, **84*b*** are drawn inward and the smooth longitudinal sections **82*a***, **82*b*** are pushed outward. The transitional area **74*a*** flexes so as to accommodate the changing cross sectional dimensions of middle section **76** without affecting the cross-sectional dimension of the periphery **74'** of lower base section **74**.

FIG. 8*c* illustrates (in somewhat exaggerated form, not necessarily to scale) the effect of a low pressure environmental condition (*i.e.*, the external pressure is lower than the internal pressure) on the lateral cross-section of the container **70**. Under such an environmental condition, the grooved longitudinal sections **84*a***, **84*b*** expand outward and the smooth longitudinal sections **82*a***, **82*b*** are draw inward. The transitional area **74*a*** flexes so as to accommodate the changing cross sectional dimensions of middle section **76** without affecting the cross-sectional dimension of the periphery **74'** of lower base section **74**.

Thus, changes in environmental conditions are compensated for in the middle section **76** and the transitional area **74*a***, **72*a***, correspondingly isolating the distal ends of

the container **70** from any distorting effects in response to changes in environmental conditions. Thus, any hermetic seal applied to the rim or top of the upper section **72** remains intact. Similarly, the generally circular cross-section of the bottom of the lower base section **74** generally maintains its circular dimensions. Furthermore, the deformation of the middle section **76** in response changes in environmental conditions is controlled by distributing the compressive and expansive forces more evenly over each longitudinal sections. Thus, the container of the present invention is capable of smoothly altering its geometry to counteract changes in environmental conditions and while maintaining its visual aesthetic appearance by avoiding random point buckling and deformation.

While the preferred embodiment of the container of the present invention shown in **FIGS. 7a-*c*** and ***8a-c***, utilizes two of the aforementioned stress dissipating mechanisms (*i.e.*, structural rigidity mechanisms and flowing geometries mechanisms) in combination with one another to fashion a container that is capable of adapting to changing environmental conditions while maintaining its visual aesthetic appearance, numerous other combinations of the various aforementioned stress dissipating mechanisms are possible.

For example, as shown in **FIGS. *9a-c*** and **FIG. 10**, in another preferred embodiment of the container of the present invention, structural rigidity mechanisms are used in combination with a multi-faceted sidewall comprised of a plurality of flowing geometries mechanisms having planar weakened panel area. The tubular body of the container **90** is comprised of a sidewall having essentially three contiguous sections: a permanently closed lower base section **94**, a middle section **96** and a sealable upper section **92**.

The tubular body of container **90** includes a plurality of flowing geometries mechanisms formed in the sidewall of the container between two tubular support structures which comprise the container's base and upper sections **94, 92**, respectively. The lower base section **94** and the upper section **92** have a generally circular lateral cross-

sections. Correspondingly, the outer periphery **94'** of lower base section **94** is also generally circular.

In order to properly focus the forces induced by changes in environmental conditions on the flowing geometries mechanism, the two tubular support structures, (*i.e.*, lower base section **94** and the upper section **92**) are designed to be generally more rigid in maintaining their dimensional shape than the middle section **96**. The tubular support structures may include structural rigidity mechanisms (*e.g.*, molded ribs or "C" beams) which serve to strengthen the structural integrity of the container and channel forces induced by changes in environmental conditions to the flowing geometries mechanism. For example, in the present instance, the upper section **92** includes a structural rigidity mechanism in the form of an annular groove **98*a*** which traverses about the longitudinal axis of the container in a wavy sinusoidal pattern.

The middle section **96** is a multi-faceted sidewall comprised of a plurality of adjacently positioned flowing geometries mechanisms formed therein. Each of the flowing geometries mechanisms is comprised of a planar weakened panel area (*e.g.*, **96*a***, **96*b***, **96*c***), each of which is connected to the lower base section **94** and the upper base section **92** by lateral flexible hinge areas (*e.g.*, **94*a***, **94*b***, **94*c*** (not shown) and **92*a***, **92*b***, **92*c***, respectively) formed in the lower base section **94** and the upper section **92**. The lateral flexible hinge areas (*i.e.*, **94*a***, **94*b***, **94*c*** (not shown) and **92*a***, **92*b***, **92*c***) allow the weakened panel areas (*i.e.*, **96*a***, **96*b***, **96*c***) to flex in response to changes in environmental conditions thereby allowing the sealed container to contract and expand its internal volume in a smooth and uniform manner. While the container's volumetric geometry or shape is allowed to smoothly adjust to changes in environmental conditions, the deformation is controlled so as not to detract from the container's commercial presentation.

The flowing geometries mechanisms effectively isolate the distal ends of the lower base section **94** and the upper section **92** from distortion forces imparted on the container, which are induced in response to changes in environmental conditions. Thus,

any hermetic seal applied to the rim or top of the upper section **92** remains intact. Similarly, the generally circular cross-section of the bottom of the lower base section **94** generally maintains its circular dimensions. Furthermore, by distributing the compressive and expansive forces more evenly over the plurality of flowing geometries mechanisms, the deformation of the middle section **96**, which counteracts changes in environmental conditions, is more controlled and balanced. Thus, the container **90** of the present invention smoothly alters its geometry to compensate for changes in environmental conditions, while maintaining its visual aesthetic appearance by avoiding random point buckling and deformation.

Referring once again to **FIGS. 9*a-c***, and particularly in **FIG. 10** wherein a lateral cross-sectional view of the middle section **96** is depicted, while the middle section **96** of the preferred embodiment of the container **90** includes three adjacently positioned flowing geometries mechanisms that bound an interior space **100** in a generally triangular configuration, the present invention also envisions containers having more than three flowing geometries mechanisms. For example, a container may comprise a middle section **96** having a lateral cross section that is generally quadrangular, pentagonal, or hexagonal, *etc.*, depending upon the number of adjacently positioned flowing geometries mechanisms used. In addition, the lateral cross sectional geometry of the middle section **96** of a container may be dimensioned so as to correspond with the lateral cross sectional geometry of an enclosed product stack. Moreover, as noted previously and illustrated in **FIGS. 6*a*** and **6*b***, such a container may be designed so that a small annular space exists between the outer periphery of the enclosed product stack and the planar weakened panel area of the container so as to aid in the manufacturing and packaging process. The size of the such a container may be designed such that when hermetically sealed, the inner wall of the weakened panel area may contact the outer periphery of the enclosed product stack when the container contracts, thereby limiting the amount of controlled deformation. The enclosed product stack may actually provide some measure of lateral structural support to the sidewall of the hermetically sealed container when the internal pressure of the container is less than the ambient atmospheric pressure.

Referring now to **FIGS. 11*a-b***, additional preferred embodiments of the container **1100**, **1100'** of the present invention may be fashioned by incorporating the other previously discussed stress dissipating mechanisms into the preferred embodiment of the container **90** shown in **FIG. 9*a***. For example, in **FIG. 11*a***, the container **1100** incorporates a floating panel mechanism into the planar weakened panel area (*e.g.*, **960*a***, **960*b***, **960*c***) of each flowing geometries mechanisms. The floating panel mechanisms are each comprised of a stable panel area (*e.g.*, **962a**, **962b**) defined by an encompassing flexible corrugated suspension ring (*e.g.*, **964a**, **964b**) formed within the confines of a weakened panel area (*e.g.*, **960*a***, **960*b***) of a flowing geometries mechanism. The flexible corrugated suspension ring (*e.g.*, **964a**, **964b**) surrounding the stable panel area (*e.g.*, **962a**, **962b**) allows the entire stable panel area (*e.g.*, **962a**, **962b**) to move flex uniformly (*i.e.*, spring in and out) without randomly distorting or buckling the container. Thus, both the flowing geometries mechanisms and the floating panel mechanism incorporated therein, work in combination to counteract the compressive and expansive forces induced by changes in environmental conditions. Thus, the container **1100** smoothly alters its geometry in response to environmental conditions while maintaining its visual aesthetic appearance by avoiding random point buckling and deformation.

In another example, illustrated in **FIG. 11*b***, the container **1100'** further incorporates a morphing geometries mechanism and structural rigidity mechanisms in the form of three-dimensional figures **930**. The three-dimensional figures **930** are typically positioned in a region of the container requiring added strength and stiffness. For example, in the container **1100'** shown in **FIG. 11*b***, the three-dimensional figures **930** are formed in the sidewall of the lower base section **940**, which has a generally circular lateral cross-section. As noted in previous examples, the lower base section **940** (as well as the upper section **920**) is generally designed to be more rigid so as to maintain its dimensional shape in order to properly focus the forces induced by changes in environmental conditions on the flowing geometries mechanisms.

Additionally, as shown in **FIG. 11*b***, the distal end of the lower base section **940** the container **1100'** is extended so as to allow a morphing geometries mechanism to be fashioned therein. The structure of the morphing geometries mechanism comprises an annular bellows means **954**. As illustrated in previous examples shown in **FIGS. 5*a-b***, the annular bellows means **954** expands (as shown in **FIG. 5*a***) and contracts (as shown in **FIG. 5*b***) along the container's longitudinal axis allowing a hermetically sealed container to repeatedly increase or decrease its internal volume to compensate for changing environmental conditions. Thus, the morphing geometries mechanism in conjunction with the flowing geometries mechanisms and the floating panel mechanism incorporated therein, work in combination to counteract the compressive and expansive forces induced by changes in environmental conditions. Thus, the container **1100'** smoothly alters its geometry in response to environmental conditions while maintaining its visual aesthetic appearance by avoiding random point buckling and deformation.

It will now be evident to those skilled in the art that there has been described herein an improved container for storing fragile food products, and more particularly, to an improved blow molded container for storing potato chips and/or crisps, corn based chips and/or crisps, cookies and the like which is capable of adapting to changing environmental conditions while maintaining its visual aesthetic appearance. Although the invention hereof has been described by way of preferred embodiments, it will be evident that other adaptations and modifications can be employed without departing from the spirit and scope thereof. Thus, multiple stress dissipating mechanisms may be utilized in a single container. Additionally, while the containers of the present invention illustrated in the Figures have a generally circular traverse cross section, it is understood that the collection of stress dissipating mechanisms utilized in containers of the present invention may be employed on any containers having a generally annular traverse cross section. Thus, in addition to containers having a circular traverse cross-section, alternative embodiments of the container of the present invention may have a traverse cross section which is generally oval in shape. The terms and expressions employed herein have been used as terms of description and not of limitation; and thus, there is no

intent of excluding equivalents, but on the contrary it is intended to cover any and all equivalents that may be employed without departing from the spirit and scope of the invention.